CHARACTERIZATION OF LUNAR MINERALOGY: THE MOON MINERALOGY MAPPER (M^3) ON CHANDRAYAAN-1. C. M. Pieters[1], J. Boardman[2], B. Buratti[3], R. Clark[4], J-P Combe[5], R. Green[3], J. W. Head III[1], M. Hicks[3], P. Isaacson[1], R. Klima[1], G. Kramer[5], S. Lundeen[3], E. Malaret[7], T. B. McCord[5], J. Mustard[1], J. Nettles[1], N. Petro[8], C. Runyon[9], M. Staid[10], J. Sunshine[11], L. Taylor[12], S. Tompkins[13], P. Varanasi[3] [1]Dept. Geological Sciences, Brown University, Providence, RI 02912 (Carle_Pieters@brown.edu), [2]AIG, [3]JPL, [4]USGS Denver, [5]Bear Fight Center, WA, [6]ISRO-PRL, [7]ACT, [8]NASA Goddard, [9]College of Charleston, [10]PSI, [11]Univ. MD, [12]Univ. Tenn., [13]DARPA.

The Moon Mineralogy Mapper (M^3, pronounced "m-cube") is a state-of-the-art high spectral resolution imaging spectrometer that is orbiting the Moon on Chandrayaan-1, the Indian Space Research Organization (ISRO) mission to the Moon. M^3 is one of several foreign instruments chosen by ISRO to be flown on Chandrayaan-1 to complement the strong ISRO payload. M^3 is a NASA Discovery Mission of Opportunity selected through peer-review as part of the SMD Discovery Program.

The type and composition of minerals that comprise a planetary surface are a direct result of the initial composition and later thermal and physical processing. Lunar mineralogy seen today is a direct record of the early evolution of the lunar crust and subsequent geologic processes. Specifically, the distribution and concentration of individual minerals or groups of minerals is closely tied to magma ocean products, lenses of intruded or remelted plutons, basaltic volcanism and fire-fountaining, and any process (e.g. cratering) that might redistribute or transform primary and secondary lunar crustal materials. The primary *science* goal of M^3 is to characterize and map lunar surface mineralogy in the context of its geologic evolution, and the primary *exploration* goal is to assess and map lunar mineral resources at high spatial resolution to support planning for future, targeted missions.

M^3 is first and foremost a near-infrared spectrometer designed to accurately measure diagnostic mineral absorption features. To meet the above science and exploration goals, M^3 acquires spectra in image format (all spectral channels co-registered to < 0.1 pixel). M^3 operates in two measurement modes as summarized below.

M^3 Measurement Modes

All M^3 Spectroscopic data (from 100 km orbit)**:**
40 km FOV, contiguous orbits
0.70 to 3.0 µm [0.43 to 3.0 µm achieved]

***Targeted Mode*: Full Resolution Science targets**
70 m/pixel spatial (600 pixel crosstrack)
10 nm spectral [260 bands]

***Global Mode*: Lower Resolution Global Coverage**
140 m/pixel spatial (300 pixel crosstrack)
20 & 40 nm selected (85 bands, averaging)

In February 2009, Chandrayaan-1 completed its primary commissioning phase. During this initial period M^3 operated principally in Global Mode. The low resolution Global Mode M^3 coverage achieved for the nearside is shown in Figure 1. A closer view of one band of several neighboring M^3 swaths is shown in Figure 2. Both images are compressed to meet abstract requirements. Pre-calibration assessment of these data (over one billion spectra) indicates they are of excellent quality, meeting all instrument requirements for science. Early results are presented in [1, 2]; a descriptive overview of M^3 is found in [3] along with other Chandrayaan-1 instruments.

At least three full optical imaging periods are planned over the next two years. For M^3, we have two prime measurement periods in each imaging period. Our plans are to complete M^3 coverage for the entire Moon using the 140 m Global mode and to then acquire optimum full resolution data (Target mode) for the highest priority science targets.

References: 1) Pieters et al., 2009, *LPSC40* #2052 2) Green et al., 2009, *LPSC40* #2307. 3) Pieters et al., 2009, *Current Science*, Vol. 96, No. 4.

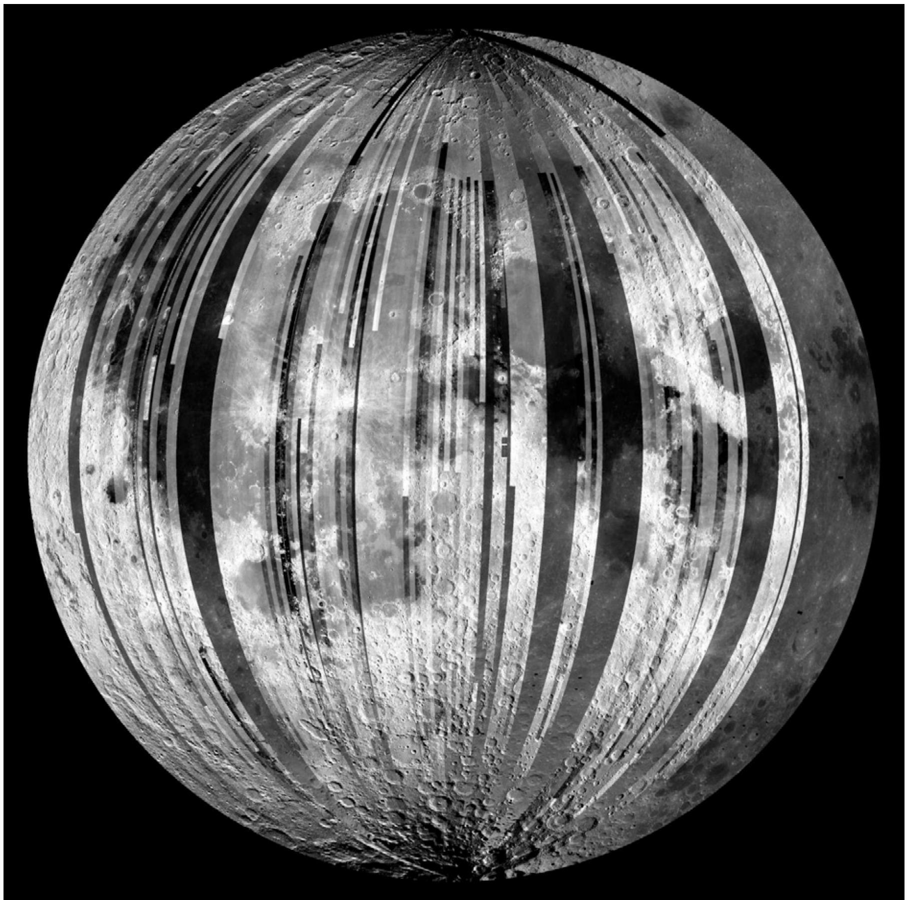

Figure 1. Overview of M^3 Global mode coverage acquired in February at the end of commissioning phase of the first optical period of Chandrayaan-1. Each M^3 data swath is 40 km wide. Shown is one channel of M^3 data. No photometric corrections have been made, but since each swath is scaled independently, swath boundaries are evident. (Background is Clementine)

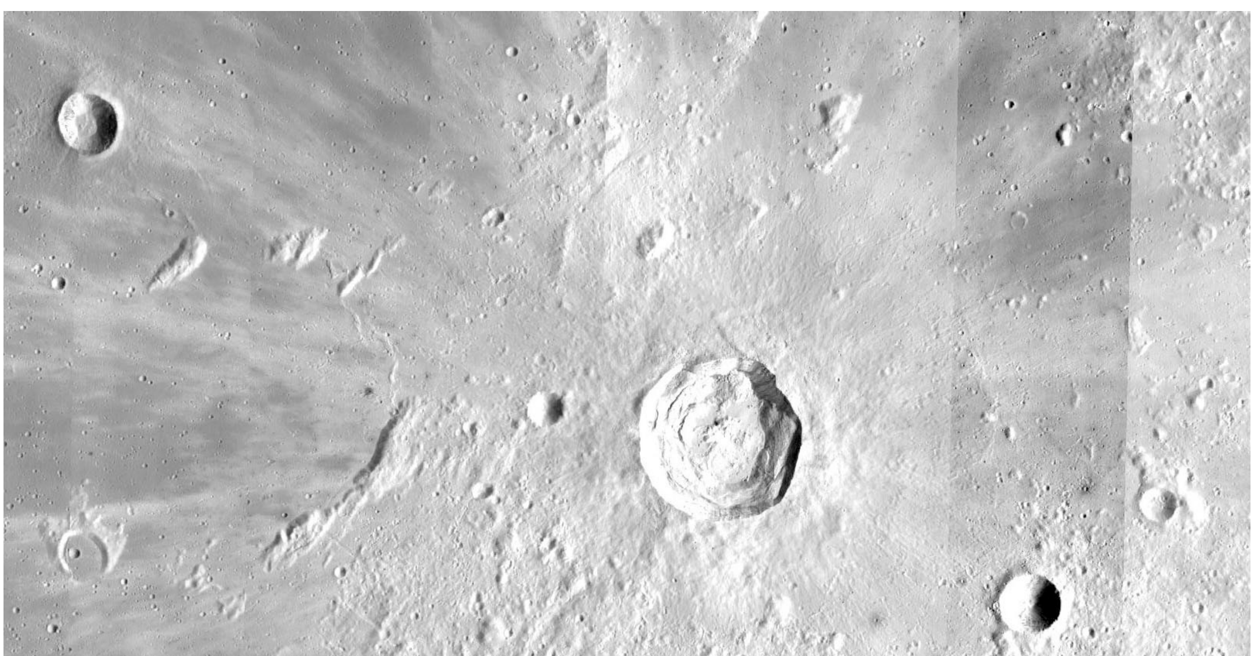

Figure 2. Subset of Fig. 1 containing Kepler crater. This M^3 image includes 8 orbits of data. A M^3 spectrum exists for each pixel.